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F2P

F2G

A5R

F2V

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A61M F16L

(54) Plug

(57) A plug adapter 18 for use with a connector 10 in an airway path of a respiratory system which includes an outer wall 50 and a conical inner wall 63 extending downwardly within the outer wall. The outer wall forms a first bottom portion 59 including an aperture 61 therein. The aperture 61 provides guiding and sealing engagement of a medical device 80 eg a catheter upon insertion through the plug adapter. The conical inner wall includes a second annular bottom portion 67 with a slit 71 therein which sealingly closes the airway path upon withdrawal of the medical device 80 from the plug adapter.

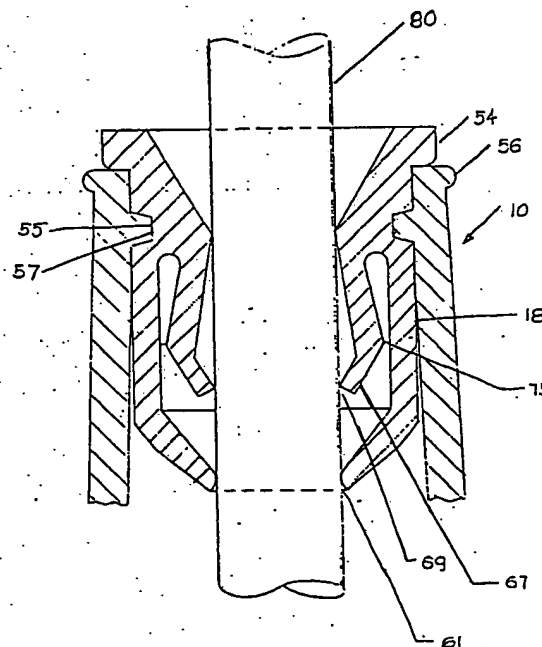
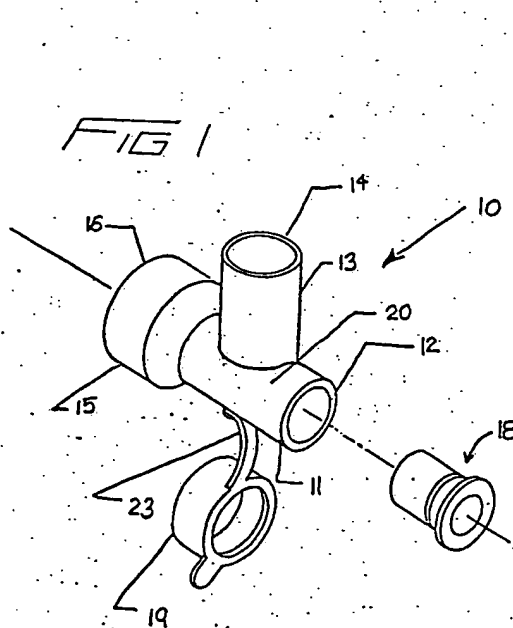


FIG 5

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FIG 1

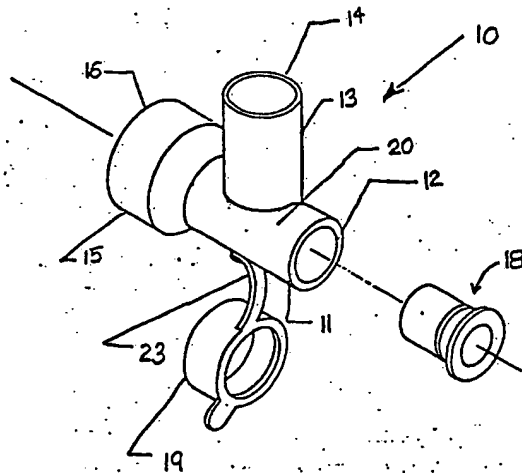


FIG 2

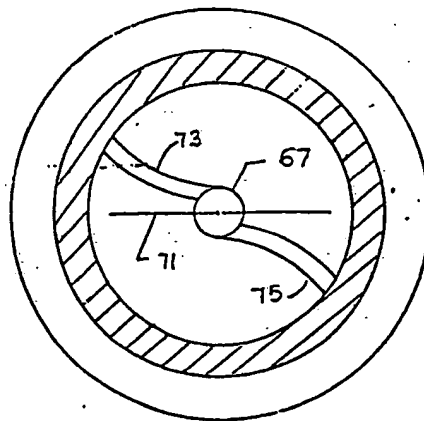
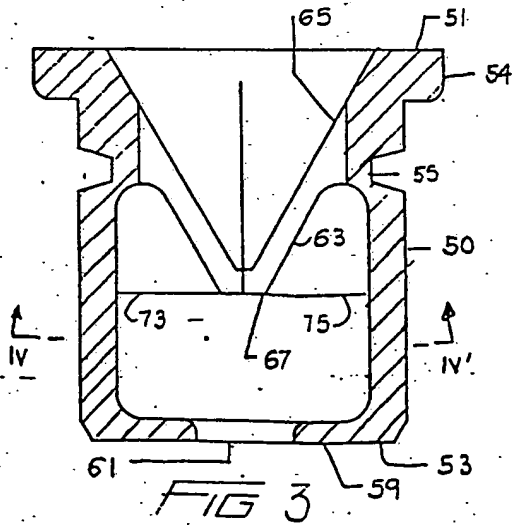
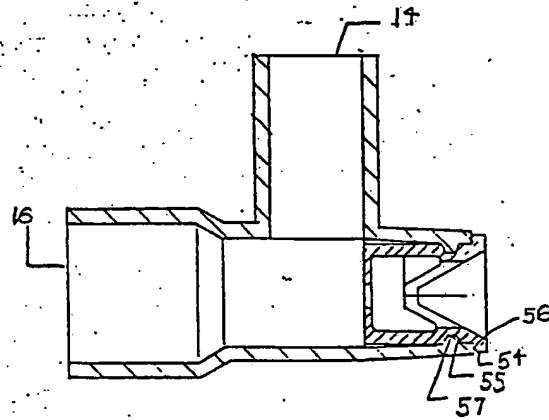


FIG 4

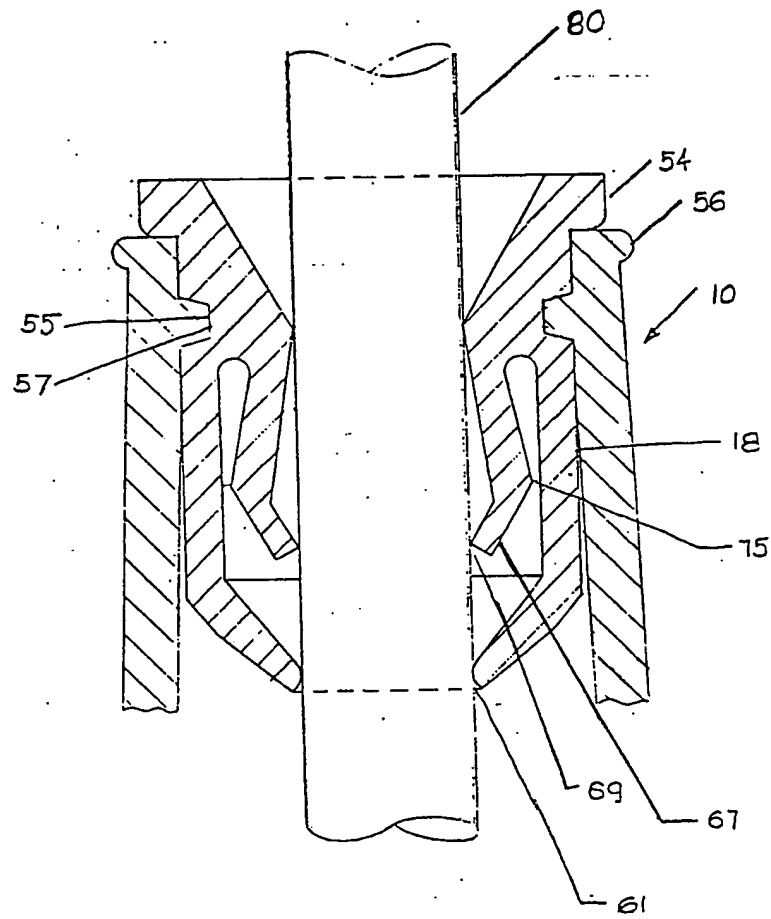


FIG 5

## ACCESSORY SEALING PLUG FOR USE IN VENTILATOR CIRCUITS 2199630

Background of the Invention

Devices typically inserted into a patient's respiratory system for ease, assistance or control of the respiratory function must be connected to differing types of equipment used for monitoring, sampling, controlling and/or enhancing the respiration of the patient. In particular, different means such as connectors or adapters are used on the outer end of the tracheostomy or endotracheal tube for communicating a ventilating apparatus with the patient's lungs and permitting the insertion of a vacuum tube or the like to relieve congestion in the patient's airways.

During continuous mechanical ventilation the use of a positive end expiratory pressure (P.E.E.P.) may be involved. When ventilator assisted breathing is involved it is desirable not to interrupt breathing during a ventilation period. However, it is frequently necessary to use suction catheters to suction airways and to maintain proper bronchial hygiene. Also visual examination of the patient's airways and lungs is often required making it necessary to introduce examining instruments into and down the air passageway.

It is known in the art to provide connector members with different types of valves, regulators and plugs which allow insertion of suction catheters or examining instruments when the ventilation provides pressurized air without losing the positive pressure. U. S. Patent No. 4,416,273 to Grimes describes a connector valve assembly for admission of catheters through endotracheal tubes and particularly to a valve comprising several elements constituting sealing means such as a cap and check valve. However, there is still a need to provide an improved, reliable, self-resealable pathway which exhibits superior pressure retention characteristics in a positive pressure environment comparable to devices known in the art.

### Summary of the Invention

It is an object of the present invention to provide a plug member for use in conjunction with the connector devices to provide an improved reliable resealable pathway which  
5 exhibits good pressure retention characteristics in a positive pressure environment.

It is another object of the present invention to provide a plug adapter which also provides a self-cleaning action on  
10 the inserted component, thus protecting the critical seal from contaminants which would cause a reduction in performance characteristics.

### Detailed Description of the Drawings

Figure 1 shows a connector assembly with the sealing  
15 plug adapter withdrawn and an open path into the airway.

Figure 2 shows a cross-section of a connector assembly with the plug adapter inserted thereinto.

Figure 3 shows in enlarged detail a cross-section of the  
20 plug adapter.

Figure 4 shows a cross-section of the plug adapter of Figure 3 taken along lines IV-IV'.

Figure 5 shows an enlarged detail of the cross-section of the plug adapter with a catheter or other tubular device  
25 inserted therethrough.

### Detailed Description of the Preferred Embodiment

Figure 1 shows a perspective view of a connector member 10 which has a main hollow cylindrical body 20. Connector member 10 includes a first section 15 which defines a

tracheal tube portion 16 at its end, and a second section 11 defining suction port portion 12. A third section 13 extends outwardly, is oriented at an angle with respect to the first and second sections 11, 15, and defines a respiratory port tube portion 14 at its end.

As shown in Figures 1 and 2 the connector assembly is also provided with plug adapter 18 which fits securely into the open ended portion 12 of the connector member 10. Connector assembly 10 is also provided with cap 19 which is adapted to fit over the portion 12 of the second section 11 to protect the plug 18 inserted into the connector member. Cap 19 includes flexible strap 23 which removably connects the cap to the connector member body.

Figure 3 shows in enlarged detail a cross section of a view of the preferred embodiment of the plug adapter 18 according to the present invention. Plug adapter 18 comprises an outer cylindrical wall 50 including an upper end 51 and lower end 53. An outwardly extending wall flange 54 is formed at the upper end 51 of the outer wall 50. The outer wall also includes recess 55 formed below the flange 54.

As shown in Figure 2 when the plug is positioned within the suction port portion 12 of the connector member 10, flange 54 of the plug member 18 rests on corresponding rim 56 formed at the suction port portion 12 of connector member 10. The inner wall of second section 11 of the connector 10 is provided with extremity 57 matching the shape of recess 55 in the plug outer wall for locking the plug with the connector body and preventing unintended withdrawal of the plug member 18 during the respiration process, during suction or when other instruments are inserted for various diagnostic functions. However other means can be provided to secure

positioning of the plug adapter 18 within the suction port 12 of the connector member 10. Outer wall 50 of the plug 18 extends inwardly at its lower end 53 to form a first bottom portion 59 which defines an aperture 61. Aperture 61 constitutes a first guiding and sealing means for sealingly engaging a medical device inserted through the plug adapter 18 into the connector member 10, as shown in Figure 5. Plug adapter 18 further includes an inner conical wall 63 which extends downwardly within the outer wall 50 towards first bottom portion 53. Inner conical wall 63 has a first end 65 which extends towards upper portion 52 of the outer wall 50. The inner wall 63 includes an angular second bottom portion 67 shown in Figure 4. Second bottom portion 67 is spaced apart from first bottom portion 59. Second bottom portion 67 includes a slit 71. Support ribs 73, 75 are provided for connecting the inner conical wall 63 to outer wall 50.

The use of support ribs 73, 75 in a structure of the plug adapter 18 provides resistance to positive pressure deformation and improved mechanical strength in a positive pressure environment.

Operation of the plug adapter 18, according to the present invention, can be described in several stages. In stage one, shown in Figures 3 and 4, while no medical device is inserted through plug adapter 18, the conical inner wall 63 with slit 71 and supporting ribs 73, 75 remains sealingly closed during P.E.E.P. and/or normal ventilation. The seal of the system is maintained without the presence of a cap or plug as was necessary in the connectors using the plugs of the prior art.

In stage two, shown in Figure 5, when a medical device 80 such as a catheter is inserted into the plug adapter 18, slit 71 in angular bottom 67 of conical wall 63 opens and

allows admission of the catheter or other medical instrument therethrough. The conical structure of the inner wall 63 also performs a guiding function while the catheter or other medical instrument is being directed towards the aperture 61 in the first bottom portion 59 of inner wall 50. After catheter 80 passes through aperture 61 in the first bottom portion 59 the aperture 61 assumes the function of a sealing mechanism allowing maintenance of the proper P.E.E.P. and/or ventilation pressure in the system.

10 In the third stage after withdrawal of the catheter from the plug adapter 18, the sealing function is again performed by the second sealing means comprising the slit 71 in the annular portion 67 of the inner conical wall 63. In the preferred embodiment, the plug adapter 18 is made of flexible material such as silicone. Other polymeric materials exhibiting resilient qualities can also be used in manufacturing plug adapter 18. As a result of the resilient action the slit sealingly closes and maintains the seal of the system. Support ribs 73, 75 allow the conical inner wall to maintain its designed geometry and/or return to its original geometry after transferring from stage three to stage one. The use of support ribs 73, 75 ensures that the mating closure surfaces of the slit 71 in the annular portion 67 of the second bottom portion do not distort under normal operating ventilator pressures.

The first sealing and guiding means consisting of aperture 61 performs another important function. The annular surface of aperture 61 protects the second guiding and sealing means by performing a wiping/cleaning action on the inserted instrument so that no contamination and undesired products are deposited on the slit 71 which would otherwise prevent proper sealing desired in stage one of the plug adapter device.



The plug adapter device according to the present invention can be used with various tracheal type connectors such as a standard 15 mm elbow connector, swivel connector, etc.

5        While a particular embodiment of the invention has been shown, it should be understood that the invention is not limited thereto, since modifications may be made, and it is contemplated to cover by the appended claims any such modifications as fall within the spirit and scope of the  
10 invention.

CLAIMS

1. A plug member for use with a connector in an airway path of a respiratory system, said plug comprising: an outer wall having upper and lower ends, said lower end of said outer wall extending inwardly to form a first bottom portion at said lower end, said bottom portion defining an aperture therein, said aperture constituting a first means for guiding and sealingly engaging a medical device, and a second means for guiding and sealingly engaging said medical device, said first and second means adapted to guide and sealingly engage said medical device while being inserted through said plug member into said connector, said second means sealingly closing said airway path after said medical device is withdrawn from said plug member.
2. A plug member according to claim 1, wherein said second means for guiding and sealing comprises an inner conical wall extending downwardly within said outer wall towards said first bottom portion of said outer wall, said inner wall having a first and second end, said first end of said inner wall being connected to said outer wall at said upper end of said outer wall, said inner wall comprising an angular second bottom portion spaced at a distance from said first bottom portion said second bottom portion having a slit therein.
3. A plug member according to claim 1 or 2, comprising a flexible material.

4. A plug member according to claim 2 or claim 3 dependent on claim 2 further comprising supporting means between said outer wall and said inner wall at said second bottom portion.
5. A plug member according to claim 4, wherein said supporting means comprises a plurality of ribs.
6. A plug member substantially as hereinbefore described with reference to the accompanying drawings.